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Research Note

New Host and Distribution Records for Coccidia (Apicomplexa: Eimeriidae) from North American Lizards (Reptilia: Sauria)

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ABSTRACT: Four hundred twenty-three lizards, representing 33 species within 7 families (Anguidae, Crotaphytidae, Gekkonidae, Phrynosomatidae, Polychridae, Scincidae, Teiidae) were examined for coccidia. Eighty-two (19%) lizards harbored coccidia. Eighty-four percent of the infected lizards were gekkonids (69/139 or 50%) while 6 non-gekkonid families (13/283 or 5%) accounted for 16% of infected lizards. New host records are reported for *Isospora scinci* Upton, McAllister, and Trauth, 1991, from the broadhead skink, *Eumeces laticeps,* and *Eimeria sceloporis* Bovee and Telford, 1965, from the crevice spiny lizard, *Sceloporus poinsettii.* In addition, this represents the first report of *E. sceloporis* from Texas.

KEY WORDS: Apicomplexa, Coccidia, Eimeriidae, *Isospora scinci, Eimeria sceloporis,* lizards, Gekkonidae, survey, prevalence, Reptilia, Sauria.

Between March 1986 and December 1993, we conducted surveys on protozoan parasites of select herpetofauna of the southcentral and southwestern United States and Mexico and found several species of lizards harboring coccidia. Further examination revealed 6 previously undescribed coccidia, which we have since described as new (McAllister et al., 1988, 1990, 1991a; Upton et al., 1988, 1991), or either redescribed (McAllister and Upton, 1989) or provided new host records (McAllister et al., 1991b). Herein, we add a new locality record and 2 additional host records and summarize our data on the coccidia of 7 families of North American lizards.

Four hundred twenty-three saurians (see Table 1) were collected by hand, noose, or shot with .22 caliber rat shot from 16 counties or parishes in Arkansas, 24 in Texas, 2 in Louisiana, and 1 each in New Mexico and Oklahoma, and from the state of Veracruz, Mexico. Specimens were returned to the laboratory and intestinal contents and feces were examined for coccidia following previously published methods (Upton et al., 1988). Except for lizards collected in Mexico, which were released, host voucher specimens are deposited in the Arkansas State University Museum of Zoology (ASUMZ) and the Carnegie Museum of Natural History (CM).

Of the 423 individual lizards, representing 33 species within 7 families, 82 (19%) were found to harbor 9 species of coccidians (Table 1). Eighty-four percent of these were gekkonids as 69 of 139 (50%) had 4 species of eimerians. The remaining 16% of the infected lizards were in 4 families as 3 of 131 (2%) of the phrynosomatids had a single eimerian, 2 of 14 (14%) of the polychrids had a caryosporan, 7 of 59 (12%) of the scincids had an eimerian and an isosporan, and 1 of 58 (2%) of the teiids had an eimerian. Three anguids and 18 crotaphytids were negative. There is a significant difference in prevalence of coccidia among gekkonids and non-gekkonids ($\chi^2 = 118.0$, 1 df, $P < 0.00001$). If gekkonids are excluded from the data set, only 13 of 283 (5%) of the lizards were infected.

A new host record was documented for *Isospora scinci* Upton, McAllister, and Trauth, 1991, in the broadhead skink, *Eumeces laticeps* (Schneider, 1801). The infected juvenile male skink (ASUMZ 19148, snout–vent length = 70 mm) was collected on 18 August 1993 in Independence County, Arkansas, 12.1 km NW Possum Grape at Gold Mine Springs. Three additional Arkansas *E. laticeps,* 2 from Desha County and 1 from Searcy County were negative. *Isospora scinci* was originally described from five-lined skinks, *Eumeces fasciatus* (Linnaeus, 1758) from Van Buren and Woodruff counties, Arkansas (Upton et al., 1991). These sites are 111 km west and 54 km southeast of the new locale, respectively. This finding was not surprising given that these skinks are broadly sympatric throughout their range (Conant and Collins, 1991).

Sporulated oocysts of an eimerian matching the description of *Eimeria sceloporis* Bovee and

Table 1. Lizards surveyed and the coccidian species collected.

Lizard family/species*	Locality	Prevalence†	Coccidian
Anguidae			
Ophisaurus attenuatus	Arkansas	0/2 (0%)	—
	Texas	0/1 (0%)	—
Crotaphytidae			
Crotaphytus collaris	Texas	0/17 (0%)	—
C. reticulatus	Texas	0/1 (0%)	—
Gekkonidae			
Cyrtopodion scabrum	Texas	8/20 (40%)	*Eimeria lineri*
Hemidactylus frenatus	Texas	7/12 (58%)	*E. dixoni*
H. mabouia	Mexico	1/1 (100%)	*E. boveroi*
H. turcicus	Louisiana	3/7 (43%)	*E. lineri*
	Texas	36/99 (36%)	*E. lineri*
	Texas	14/99 (14%)	*E. turcicus*
Phrynosomatidae			
Cophosaurus texanus	Texas	0/65 (0%)	—
Holbrookia lacerata	Texas	0/1 (0%)	—
H. propinqua	Texas	0/1 (0%)	—
Phrynosoma cornutum	Texas	0/6 (0%)	—
Sceloporus cyanogenys	Texas	0/1 (0%)	—
S. olivaceus	Texas	0/24 (0%)	—
S. poinsettii	Texas	1/4 (0%)	*E. sceloporis*
S. undulatus	Arkansas	0/9 (0%)	—
	New Mexico	0/1 (0%)	—
	Texas	0/1 (0%)	—
S. variabilis	Mexico	1/1 (100%)	*E. sceloporis*
	Texas	0/1 (0%)	—
Urosaurus ornatus	Texas	0/7 (0%)	—
Uta stansburiana	Texas	0/8 (0%)	—
Polychridae			
Anolis carolinensis	Arkansas	0/4 (0%)	—
	Louisiana	2/10 (20%)	*Caryospora ernsti*
Scincidae			
Eumeces anthracinus	Arkansas	0/2 (0%)	—
E. fasciatus	Arkansas	3/14 (21%)	*Eimeria fasciatus*
	Arkansas	3/14 (21%)	*Isospora scinci*
E. laticeps	Arkansas	1/4 (25%)	*I. scinci*
E. obsoletus	Texas	0/2 (0%)	—
E. septentrionalis	Texas	0/3 (0%)	—
E. tetragrammus	Texas	0/8 (0%)	—
Scincella laterale	Arkansas	0/15 (0%)	—
	Oklahoma	0/5 (0%)	—
	Texas	0/6 (0%)	—
Teiidae			
Cnemidophorus gularis	Texas	0/22 (0%)	—
C. inornatus	Texas	0/2 (0%)	—
C. laredoensis	Texas	0/2 (0%)	—
C. septemvittatus	Texas	0/1 (0%)	—
C. sexlineatus	Arkansas	1/28 (4%)	*E. sexlineatus*
	Texas	0/2 (0%)	—
C. tesselatus	New Mexico	0/1 (0%)	—

* Family nomenclature for iguanian lizards follows Frost and Etheridge (1989) and current scientific names follow Collins (1990).

† Number infected/number examined (percent).

Table 2. Summary of hosts, localities, and prevalence of *Eimeria sceloporis*.

Host	Locality	Prevalence	Reference
Sceloporus clarkii	Mexico	4/4 (100%)	Bovee and Telford, 1965a
S. jarrovii	Arizona	11/38 (31%)	Mitschler et al., 1993
S. magister	California	1/1 (100%)	Bovee and Telford, 1965a
		1/52 (2%)	Telford, 1970
S. poinsettii	Texas	1/4 (25%)	This paper
S. occidentalis	California	?	Bovee and Telford, 1965a
	Washington	149/178 (84%)	Clark and Colwell, 1973
S. variabilis	Mexico	2/2 (100%)	McAllister and Upton, 1989

Telford, 1965, were found in the feces of a gravid adult female (ASUMZ 19021, SVL = 119 mm) crevice spiny lizard, *Sceloporus poinsettii* Baird and Girard, 1852. The host was collected on 28 May 1993 from Llano County, Texas, 3.2 km N Enchanted Rock State Park, off FM 965. *Eimeria sceloporis* was originally described from Clark's spiny lizards, *Sceloporus clarkii* Baird and Girard, 1852, western fence lizards, *Sceloporus occidentalis* Baird and Girard, 1852, and desert spiny lizards, *Sceloporus magister* Hallowell, 1854 (Bovee and Telford, 1965a). This coccidian is apparently genus specific for it was reported from 6 species of sceloporiine lizards of the southwestern and Pacific northwestern United States and Mexico (Table 2). In addition, Mitschler et al. (1993) recently provided a redescription of *E. sceloporis* from Yarrow's spiny lizard, *Sceloporus jarrovii* Cope, 1875.

It is somewhat difficult to explain the disparity in prevalence of coccidia among the lizard families. However, the number of previous reports of coccidia from saurian hosts (other than gekkonids) in North America suggests a low prevalence of infection. Indeed, Matuschka and Bannert (1987) and Matuschka (1989) collectively list 30 species of *Eimeria* and 19 species of *Isospora* from lizards, excluding gekkonids. Of the species listed, only 20% of the eimerians and 11% of the isosporans are known from North America (6 from phrynosomatids, 2 from xantusids, and 1 from a scincid). In addition, all of the lizards that have been reported to serve as hosts for coccidia were collected from humid regions of the extreme western or Gulf Coastal area of the United States, in California, Louisiana, and Washington (Bovee and Telford, 1965a, 1965b; Bovee, 1966, 1969; Clark, 1970; Pellérdy, 1974; Atkinson and Ayala, 1987).

It is possible that many of the lizards from study sites did not serve as suitable hosts for coccidia because of defecation habits. Most of the lizards were observed to bask upon limestone outcroppings, logs, and miscellaneous debris. Feces deposited on the substrate were desiccated within minutes. During periods of increased lizard activity, typical substrate temperatures can range from 35 to 45°C. If these conditions predominate over the period of lizard activity, the upper high temperatures would not represent ideal conditions for coccidia to develop or remain viable. The process of oocyst sporulation is temperature dependent (Long and Joyner, 1984). For example, Lindsey et al. (1982) reported *Isospora suis* oocysts were unable to sporulate at temperatures above 37°C. Furthermore, the majority of non-gekkonid lizards were observed to be most active during the warmer periods of the day. If lizards defecated at these times, it would serve to limit viability of oocysts that have exogenous sporulation.

We believe the reason that gekkonids have a 10-fold prevalence of infection, when compared to other lizards in this study, is also related to their ecology. Most gekkonids are diverse nocturnal lizards that are distributed throughout the tropics and subtropics of the Old and New Worlds. All 4 species of geckos in this study (see Table 1) are Old World natives that have been introduced into North America and have established themselves in buildings, docks in tropical seaports, in cargoes of fruit, and other humid areas. Feces deposited in these microhabitats would tend to favor increased viability of coccidian oocysts when compared to lizards inhabiting more hostile and dryer sites. Interestingly, these data showing a lower prevalence of infection for coccidia in non-gekkonid lizards are similar to those reported for western rodents inhabiting arid environments with a low prevalence of coccidia (Ford et al., 1990; McAllister et al., 1993).

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